

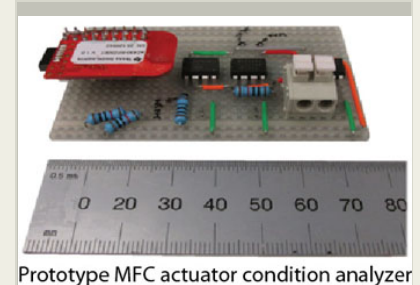
## Macro-Fiber Composite-based actuators for space, Phase I

Completed Technology Project (2015 - 2015)



## Project Introduction

This SBIR project creates a CubeSat-based on-orbit Validation System (CVS) that provides performance data for Macro Fiber Composite (MFC) piezocomposite actuators operating in space and matures this precision deployable technology through validation tests in Low Earth Orbit (LEO). NASA customers include active structures like complex space-based deployable telescopes. Phases I/II advance MFC actuator materials to Technology Readiness Level (TRL) 6 or better for space. Implications of the innovation While piezocomposites needed for active structure control have flown and are space qualified their performance under actuation and sensing has not been quantified under minimal thermal protection to enable large deployable precision structures like 10–30 m class space telescope observatories. Data is needed on the viability of piezocomposites as control actuators for space missions. MFCs also enable active structural health monitoring (SHM) techniques that expand the potential commercial market. Technical objectives CVS uses a CubeSat to conduct LEO tests. CubeSats provide low-cost rapid access to space-based testing. CVS leverages our previous NASA research and builds on our TRL 5 prototype, which is defined as a CubeSat payload. Our preliminary work found an unexpected deviation in the behavior of composite actuators reacting to thermal cycles like those experienced in LEO. Without suitable compensation, this atypical behavior could cause imprecise mechanical performance in active space structures. Phase I establishes feasibility by defining, modeling and controlling this behavior. Research description Phase I develops and validates compensation mechanisms for MFC actuators subjected to thermal cycling, and completes a TRL 5 prototype. Anticipated results Phase I provides weight, size, and power estimates updated for thermal cycle compensation and verifies that CVS fits in a CubeSat. Phase II delivers a fully operational and certified CVS CubeSat.



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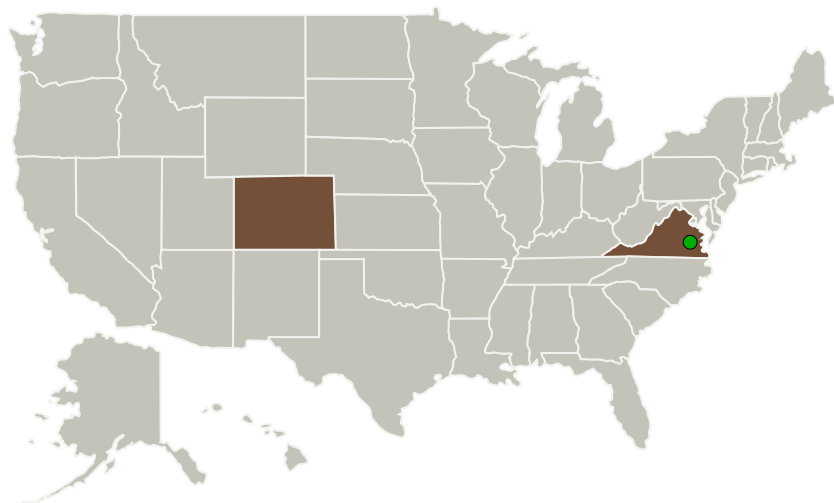
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Extreme Diagnostics, Inc.	Lead Organization	Industry	Boulder, Colorado
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

## Primary U.S. Work Locations

Colorado	Virginia
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## Project Transitions

▶ **June 2015:** Project Start

✓ **December 2015:** Closed out

**Closeout Summary:** Macro-Fiber Composite-based actuators for space, Phase I Project Image

**Closeout Documentation:**

- Final Summary Chart Image(<https://techport.nasa.gov/file/139071>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Extreme Diagnostics, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

Robert B Owen

**Co-Investigator:**

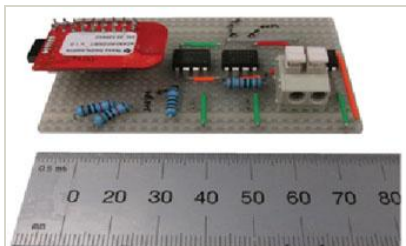
Robert Owen

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## Images



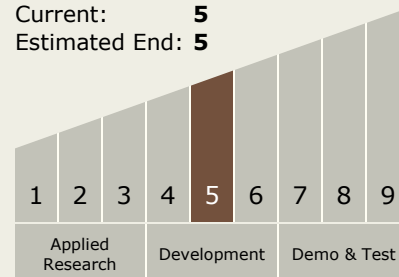
Prototype MFC actuator condition analyzer

### Briefing Chart Image

Macro-Fiber Composite-based actuators for space, Phase I  
(<https://techport.nasa.gov/image/131348>)

## Technology Maturity (TRL)

Start: **5**  
Current: **5**  
Estimated End: **5**



## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
    - └ TX08.1.3 Optical Components

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System